

field, Illinois, 21 per cent. At Fort Smith, Arkansas, the difference was 12 per cent., but with reversed conditions, the upper air humidity being the higher.

The vapour pressures were compared with others obtained at various times at equal altitudes by means of balloons and mountain observations, and found to be somewhat lower. The average value was 59 per cent., as compared with 68 for the balloon and 66 for the mountain observations. In these data the vapour pressures were represented in percentages obtained by the formula $\frac{p}{p^0}$, p representing the vapour pressure at any given altitude, and p^0 that observed simultaneously at the earth's surface.

Differences in wind direction above and at the surface were for the most part confined to a deflection toward the right at the kite. This deflection frequently increased with the altitude, but rarely exceeded 90 degrees. In some few instances, chiefly during unsettled weather, the deflection was toward the left, but not to any great extent.

At the present time efforts are being made to obtain a more improved and satisfactory vehicle for the meteorograph. If such an one can be devised, it is yet possible that the desire of the forecaster will finally be gratified with great resultant benefit both to the cause of science and to the world at large. H. C. FRANKENFIELD.

THE PRESENT CONDITION OF THE INDIGO INDUSTRY.

SINCE a previous article upon the above subject (November 1) was written, a report of the opening of the Hofmann House in Berlin has appeared in the *Times*. At the opening ceremony Prof. von Baeyer and Dr. Brunck delivered lectures upon the synthetical production of indigo. Von Baeyer's lecture dealt chiefly with the theoretical side of the question, while that of Dr. Brunck, who is one of the managing directors of the Badische Anilin und Soda Fabrik, dealt more upon the manufacturing side. As the work of von Baeyer is so well known and was referred to in the previous article, attention will only be drawn to the extremely interesting speech of Dr. Brunck.

In the first place, Dr. Brunck drew attention to the advantages of synthetic over natural or vegetable indigo, owing to its uniformity of composition, fine state of division, ready reducibility, &c. He claimed that a much less skilled operator may be employed in manipulating the dye bath than when natural indigo is used. He then went on to describe the prejudice which the synthetical indigo ("indigo pure") had to contend with when it was first placed on the market in 1897; it being stated by some that it was merely specially refined natural indigo, and by others that it was a substitute for indigo. It is extraordinary how difficult it is to make the public believe that it is possible to prepare in the laboratory a product which is identical in every respect to one which is of vegetable origin. In the case of indigo, however, there is perhaps some excuse, because the manufacturers of coal-tar products have often brought out colours which dye practically the same shades as indigo, but though not readily distinguished from it even by experts, have lacked one of the chief characteristics of indigo—fastness. But notwithstanding prejudice and keen competition, the development of the manufactory has been enormous. Dr. Brunck states that about 900,000*l.* has been invested in the indigo department of the Badische Company, and that the quantity of indigo now annually manufactured by this company alone would require the cultivation of nearly 250,000 acres of land in India.

The method of manufacture employed by the Badische

Company is that of Heumann, in which phenylglycine-ortho-carboxylic acid (anilido-acetic acid) is fused with caustic soda (*c.f.* NATURE, this volume, p. 9). When this process was first discovered, the cost of the out-going products was so great that indigo so prepared could not compete with the natural product. The *Badische Company employ more than 100 highly-trained research chemists*; to some of these the work of endeavouring to elucidate the problem, how to manufacture phenylglycine-ortho-carboxylic acid cheaply, was entrusted. Taking naphthalene, which is obtained in enormous quantities from coal tar, as starting product, the following process was worked out. The naphthalene is oxidised by highly concentrated sulphuric acid in presence of mercury or mercury salts, with production of phthalic acid. The phthalic acid is then, by a series of reactions, converted into anthranilic acid which, when combined with monochloroacetic acid, produces phenylglycine-ortho-carboxylic acid. During the oxidation of naphthalene with sulphuric acid large quantities of sulphur dioxide are produced, the loss of which would be a very serious expense. In preparing indigo upon the scale in which it is now manufactured, from 25,000 to 30,000 tons of sulphur dioxide are produced annually. But this is not lost; it is mixed with air and passed over heated oxide of iron, and is thus by catalytic action converted into sulphuric anhydride, and this by the action of water into sulphuric acid. Chlorine is required in order to prepare chloroacetic acid, and caustic soda to fuse the phenylglycine-ortho-carboxylic acid. These two products are obtained by the electrolysis of sodium chloride. As, however, the chlorine as it is first produced is not sufficiently pure, it is purified by condensing it to the liquid condition. Attention has been drawn to the details of the manufacturing process, in order to show what a determined and powerful competition the Indian indigo producer has to face.

Synthetical indigo is being used in this country, but there is a considerable difference of opinion as to whether it is as easy to dye with the artificial as with the natural product. Some dyers state that there is a difficulty in obtaining the requisite bloom and that, therefore, materials dyed with it have a flat or dead appearance; other operators seem to find no such difficulty. Practically the only drawback to materials dyed with indigo is that the dye is inclined to rub. Some dyers say that goods dyed with synthetical indigo rub more than when dyed with the vegetable indigo. This, again, is denied by others. There is also said to be a difficulty in reducing synthetical indigo. In print-work synthetical indigo certainly appears to possess an advantage, owing to its fine state of division and to the fact of its containing no foreign matter which might scratch and injure the rollers. Before natural indigo can be employed, it is necessary to have it in an exceedingly fine state of division, and in order to ensure this it is usually ground in a mill with water for several days. The artificial product, on the other hand, is sent into the market as a very fine powder or in the form of a paste. One drawback to natural indigo is the varying amounts of indigotin which different samples contain. Artificial indigo contains not only a very high percentage of indigotin, but practically no foreign matter.

Dr. Brunck is sanguine that the synthetical product will shortly overcome all competition and drive the natural product from the market; and in his address, with a *disinterestedness* which cannot but be admired, advises the Government of India to ascertain in what manner the land which has been employed for growing indigo may be best cultivated. If the advice of Dr. Brunck is taken, there will be no doubt as to the success of the artificial indigo. As showing the vast importance of the question to India, the following statistics are given. In Northern Behar there are from 250,000 to 300,000 acres of land devoted to the cultivation of indigo,

and nearly one and a half million people are employed in the industry, while three years ago the capital invested in this province was estimated at over 4,000,000*l.* The land under cultivation in Bengal was, in 1899, estimated at 452,700 acres. There seems at last to be some movement among the dry bones; the Indigo Planters' Association have employed Mr. Rawson, who is an expert upon the chemistry of dyeing, to endeavour to improve the process of manufacturing indigo, and appeals are made to the Government for help. The Government is doing its part, and has ordered that all blue cloth supplied to the Army and Navy Clothing Departments shall be dyed with *natural* indigo. At the present time the price of natural and synthetic indigo is almost the same. What will the Government do if the price of synthetic indigo becomes much less than that of natural indigo? Sir William Hudson, in August of this year, applied to the Government for a loan for a scheme of sugar cultivation, suggesting that indigo and sugar-cane should be grown in rotation. The Government, although not able to accede to his request, has sanctioned a committee to inquire into the possibilities of establishing the sugar industry in Behar.

When attention is drawn to the perilous position of the Indian indigo industry, letters are written to the papers by those connected with the production of indigo, making light of the danger, and referring to the "*real* indigo dye and German imitation." But, as Mr. Rawson, who at least is not likely to overrate the artificial indigo, said in his admirable lecture, delivered before the Society of Arts at the end of March, "all chemists who have studied the question agree that synthetic indigo is *identically* the same compound as the indigotin of natural indigo"; and again, "Providing the synthetic dye can be produced in sufficient quantity, the whole question of artificial *versus* natural indigo will resolve itself into one of cost. The Badische Company have spent nearly a million pounds in improving the manufacture of artificial indigo; at Höchst, the "Farben Fabrik" is also manufacturing artificial indigo, though at present they are only supplying the German market. In a letter to the *Times* on April 24, Prof. Armstrong asks, "Have we spent 5000*l.* in the endeavour to set our Indian indigo house in order?" For every British chemist employed it is safe to say the Germans are employing fifty; for every pound spent they are spending thousands. Is it not time to appoint a committee or commission of experts to see whether it may not be possible to increase the yield and quality of the indigo produced, and at the same time to produce it more economically?"

F. MOLLWO PERKIN.

NOTES.

PROF. POINCARÉ has been elected a foreign member of the Munich Academy of Sciences.

PROF. KLEIN has been elected a correspondant of the Paris Academy of Sciences, in the section of mineralogy. Prof. Haller has been elected a member of the Academy in succession to the late M. Grimaux.

THE Rammelsberg Memorial Lecture will be delivered at the Chemical Society by Prof. H. A. Miers, F.R.S., on Thursday, December 13.

WE notice in *Science* the announcement that Prof. Schiaparelli retired on November 1 from the directorship of the observatory at Milan, where he has been at work for the past forty years. His successor is Prof. Celoria, heretofore assistant astronomer at the observatory.

AT the annual meeting of the Royal Geological Society of Cornwall, Dr. Le Neve Foster was presented with the William Bolitho gold medal in recognition of the distinction which he

has attained as a mineralogist and also of the great services rendered by him to the society as curator during the period when he held the appointment of inspector of mines for Cornwall and Devon.

It is reported that M. Daniel Osiris, a Greek millionaire residing in Paris, has instituted a prize on the lines laid down by Mr. Nobel, though his offer is for Frenchmen only, except in a Paris Exposition year, when it becomes universal. He has set aside a sum to be awarded every three years in perpetuity to the discoverer, inventor or producer of the most noteworthy idea or object for the benefit of humanity. The prize is to be never less than 100,000 francs, and may be double that sum.

A RUMOUR, which we profoundly regret, has reached us to the effect that, owing to increasing financial difficulties, the Government of Jamaica, W.I., is obliged to retrench in the work of the museum, and that the curator, Dr. J. E. Duerden, A.R.C.S. (London), will be shortly returning to England. During his appointment in the Colony, Dr. Duerden has carried out investigations on the local aboriginal Indian remains and in marine zoology. Among the important results obtained may be mentioned the discovery of the free-swimming female medusoids of *Millepora*; the discovery that the addition of new mesenteries and septa in the coral *Porites* takes place in a bilateral manner at the dorsal or ventral aspect of the polyp, recalling the method probably followed in the ancient Rugose corals; the establishment of the fact that the order of septal formation in most *Madreporaria* follows closely the law ascertained long ago by Prof. Lacaze-Duthiers for the cycles of tentacles in *Actinixæ*. Can nothing be done to save the Colony from the opprobrium which must follow the forsaking of pure science?

THE value of anti-plague serum is a very vexed question. Versin in 1896, in China, claimed a mortality of only 7.6 per cent. in twenty-six cases treated with his serum, and the same observer in 1897, in India, using Roux's serum, stated that the mortality was only 49 per cent., as compared with 80 per cent. among the cases not treated with serum. The Indian medical officers and the German Commission, however, reported unfavourably upon his results, and the serum treatment of plague has not been adopted in India. Clemow, in India in 1899, employed both Versin's and Lustig's sera, but was unable to observe any good results from the use of either. On the other hand, in the outbreak of plague in Oporto last year, Calmette and Salimbeni claim to have obtained excellent results with the use of serum prepared at the Pasteur Institute by the most recent method—viz. by treating horses with increasing doses, first of dead and afterwards of living cultures, of plague bacilli, administered by intravenous injection during a period of five or six months. The mortality of the cases treated with serum was 15.3 per cent., as against 63.7 per cent. for the untreated cases. Calmette holds that for successful treatment the anti-plague serum must be administered in large doses, intravenously to commence with, and afterwards by repeated subcutaneous injection, early treatment being essential. The experimental results are distinctly in favour of the value of anti-plague serum both as a preventive and as a curative agent.

MR. R. HEDGER-WALLACE, formerly of the Department of Agriculture, Victoria, is giving a course of lectures on the "First Principles of Colonisation and Plantation," at the Gardens of the Royal Botanic Society of London. The remaining lectures will be delivered on November 30 and December 7 at three o'clock.

IN consequence of the annual dinner of the Institution of Electrical Engineers being fixed for Monday, December 3, the second lecture of Prof. Fleming's Cantor course at the Society of Arts, on "Electric Oscillations and Electric Waves," announced